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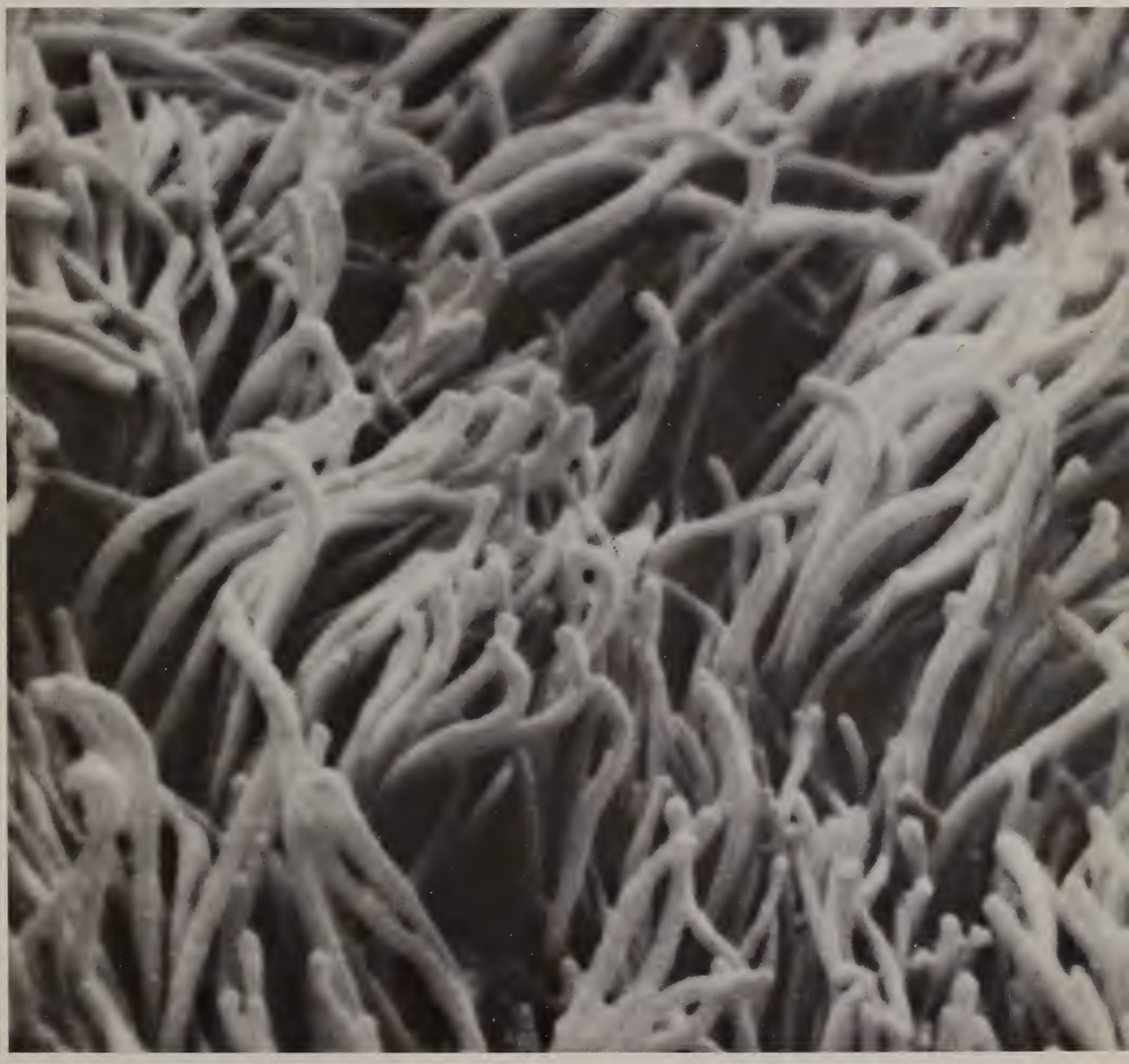
U.S. DEPARTMENT OF AGRICULTURE SEPTEMBER 1976



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September 1976/Vol. 25, No. 3

September Fantasia—An Omen of Autumn

The days are a bit shorter; the nights a mite cooler. Summer is on the wane; the slight chill in the air is a prologue to autumn.

There's a different sound and feel to the air—a different lifestyle in the making. Those who work in close harmony with the land can feel this difference—this close tie to the changing seasons.

Winter's coming, but it'll be a while yet. Here and there, a tree leaf turns rusty red and drifts to earth. Across the fields, photosynthesis is beginning to wind down for an essential rest.

The ninth month of the modern calendar, September comes from the Latin word *septem* for seven. It was the seventh month in Julius Caesar's early Roman calendar, which began in March.

September can be exhilarating. State and county fairs climax days and weeks of frenzied anticipation. There's almost too much to digest at one time—the amazing array of exhibits; the pride of the livestock shows; the pomp of the parades and bands; and the overpowering thrill of the midway. Each year, the crops, cattle, swine, poultry, and other livestock seem bigger and better. Without the help of modern research, the agricultural bounty displayed at these extravaganzas wouldn't be possible.

September also means school—the feel of new clothes, new books, different teachers. And, trying to squeeze feet that have gone barefoot all summer into confining shoes again.

The smell of autumn harvest is everywhere. The red, crunchy apples are ready to be plucked. Corn stands crackling in the breeze waiting for the picker. Farmers wait anxiously for the crops to mature and then hectically race against the clock to bring them in before it's too late. At harvest time, both backyard gardeners and farmers are rewarded for their hours of worry and work.

Agricultural research has made the difference between uncertain, meager crop yields of yesteryear and the plentiful harvest of today that not only feeds us, but is exported to feed hungry people throughout the world.

Other signs of autumn will soon be in the air. Wild geese, perhaps the most spectacular of the migratory birds, will be joined by ducks, robins, and a host of other fowl. These birds know it's September by instinct.

The cool, crisp autumn—the gateway to a new season of life—is at hand.—*M.M.M.*

Editor: *R. P. Kaniuka*

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COVER: Scanning electron photomicrograph, 5,000 X magnification, of lining in a normal cow's uterus shows healthy cilia that beat rhythmically to unite sperm and ova—assisting conception. Research suggests that abortion may ensue if mycoplasma stop or decrease the movement of cilia (PN–4115). Article begins on page 3.

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Earl L. Butz, Secretary
U.S. Department of Agriculture

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Agricultural Research Service

A mycoplasma—abortion link?

If certain mycoplasmas cause ciliostasis, as recent studies suggest, these bacteria may be responsible for abortions and temporary or permanent sterility in cattle.

Ciliostasis is the stopping of rhythmic movement by cilia, finger-like projections from the lining of tubes linking ovaries and uterus. Cilia move, or beat, toward the uterus approximately 1,200 times a minute.

Absence of ciliary activity or a decrease in the rate or vigor of the beat, ARS veterinary medical officer Ole H. V. Stalheim points out, might interfere with conception and early embryonic development at any one of several crucial events—migration of the sperm and egg, preparation of the sperm for fertilization, fertilization, movement of the fertilized egg, or its implantation in the uterus.

In studies with organ cultures at the National Animal Disease Center (P.O. Box 70, Ames, IA 50010), Dr. Stalheim found that mycoplasmas produced cessation of ciliary activity 24 to 144 hours after inoculation. The mycoplasmas in these studies were ureaplasmas isolated from genital and respiratory tracts of cattle and from the human genital tract.

Ureaplasmas have been associated with cases of unexplained infertility and reproductive failure in both animals and humans, Dr. Stalheim says, but there has been no clear evidence of the mechanism involved.

Dr. Stalheim, ARS veterinary medical officer Stanley J. Proctor, and microbiologist Joseph E. Gallagher examined the effects of ureaplasmas on small

Dr. Stalheim discusses ARS research linking mycoplasmas with abortions in cattle (0676X791–28).

pieces of bovine oviduct maintained *in vitro*. Undamaged cilia will continue to beat for several days or weeks under these conditions.

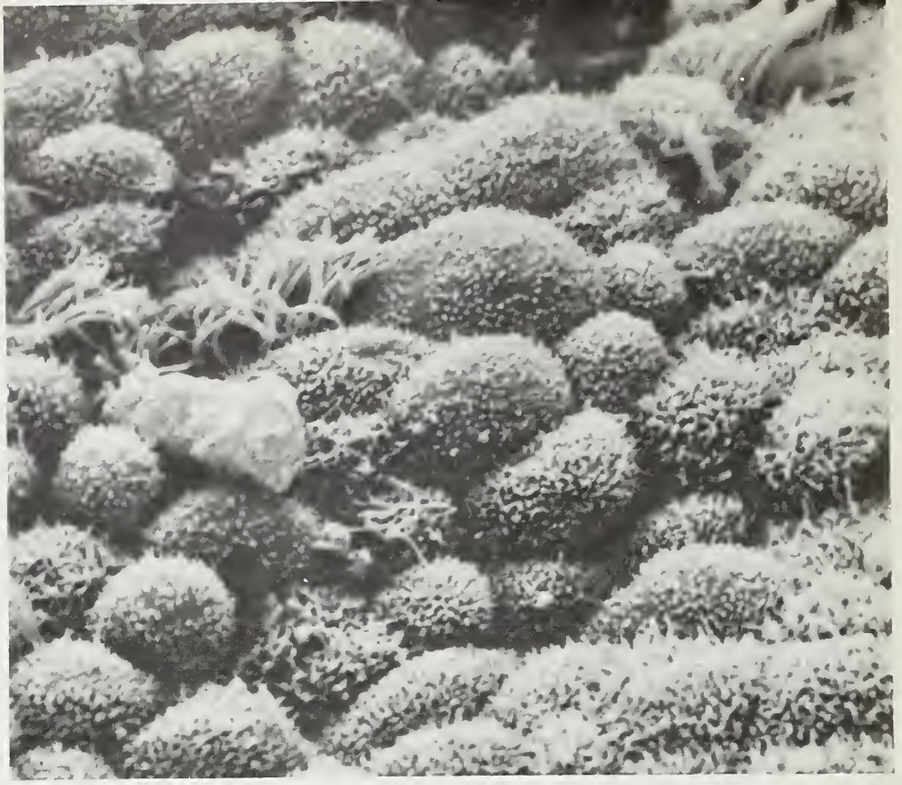
The cilia-stopping effect, they found, was dependent upon multiplication of the ureaplasmas in organ cultures. Bending of the cilia, cessation of beat, and death of cells followed in sequence. Introducing nonviable matured ureaplasmas to other organ cultures produced the same effects. The chemical nature of the toxin produced by ureaplasmas is unknown.

Additional evidence linking mycoplasmas with bovine abortion comes from a second study by Dr. Stalhiem and Dr. Proctor. This study involved a strain of the bovine subspecies of *Mycoplasma agalactiae* isolated from the reproductive tract of an arthritic heifer.

Two heifers aborted 11 and 18 days after this mycoplasma was inoculated into uterine fluids. Two other pregnant heifers, given the same mycoplasma by intraperitonal injection, showed severe inflammation of the placenta at postmortem examination 36 days after injection. Fetal death undoubtedly would have occurred if the experiment had been continued, Dr. Stalheim says. The mycoplasma was recovered from the aborted fetuses and from the heifers that received intraperitonal injections.

Other mycoplasmas have been identified as the cause of three respiratory diseases of animals—contagious pleuropneumonia in cattle, sheep, and goats; chronic respiratory disease in chickens; and infectious sinusitis in turkeys.

Medically acceptable proof that mycoplasmas cause disease has been difficult to obtain, Dr. Stalheim says. Proof that a micro-organism causes a specific disease, as postulated by Dr. Robert Koch, famous 19th century microbiologist, requires evidence that the disease agent is present in all cases of disease, that the agent produces the same disease when administered to animals, and that the agent recovered from these animals is identical with the one administered.—*W.W.M.*



Top: *A scanning electron photomicrograph of the inside of a cow's uterus made after 96 hours exposure to mycoplasmas shows bulging epithelial cells and lack of cilia (PN–4116).*
Above: *After uterine tissue was exposed to a culture of mycoplasmas for 48 hours another electron photomicrograph of 2,500 X magnification was taken. It reveals that many cilia had disappeared and those remaining are disorganized (PN–4117).*

New index for selecting sires

CATTLEMEN CAN almost "have their cake and eat it too" using a proposed index for selecting breeding animals for herd improvement.

Selecting as sires those bulls that rank high in yearling weight is receiving much attention in the industry because such bulls can contribute to desired rapid growth and large size in their offspring raised for slaughter. But there are associated disadvantages.

ARS geneticist Gordon E. Dickerson points out that selection for yearling weight inadvertently increases birth weight of calves, calving difficulty, and calf mortality, and that subsequent conception rate is lower in cows with calving difficulty. In the long term, maintenance cost for the cow-herd also increases because cows grow to a larger mature size.

Dr. Dickerson and associates at the U.S. Meat Animal Research Center (P.O. Box 166, Clay Center, NE 68933) devised selection criteria that minimize the associated disadvantages of selection on yearling weight alone but retain most of the potential gain in growth rate of progeny.

Dr. Dickerson suggests simultaneous selection *for* yearling weight and *against* birth weight, a biological possibility because these traits are not closely correlated genetically. He proposes an index of yearling weight minus 3.2 times birth weight (H=Y−3.2W).

He calculates that use of this index would reduce the rate of increase in birth weight by 55 percent and that in mature weight by 25 percent but would retain 90 percent of the potential gain in yearling weight.

This index should yield a net increase of about 6 percent in production efficiency over selection on yearling weight alone, the geneticist says, when production efficiency is defined to include the costs of reproduction losses and cow-herd maintenance.

An additional 6-percent increase in net production efficiency is possible by also including selection for thinner yearling backfat in the index, Dr. Dickerson says, but mature size is likely to increase a trifle faster. This index is yearling weight minus 3.2 times birth weight minus 2.9 times backfat thickness over the loin measured at the 13th rib (H=Y−3.2W−2.9B).

Selection for faster growth is primarily among bulls, and will increase birth weights of calves before it increases cow size, Dr. Dickerson explains. The immediate effect is that calves tend to be too big for the cows, so calving difficulty increases. Each 1-pound increase in birth weight was associated with about 1-percent increase in calving difficulty and 0.5-percent decrease in calf crop, in one study at USMARC.

Direct selection for shorter gestation, if feasible, would help to alleviate calving difficulty, because birth would occur earlier, when calves are smaller. Such selection seldom is feasible in beef cattle because individual breeding dates are not recorded. However the same objective can be achieved indirectly by selecting simultaneously for lighter birth weight and heavier yearling weight, which is genetically associated with shorter gestation length.

In the study, the scientists used individual body weights, postweaning feed consumption records, and the 12th rib carcass backfat measurements on about 1,000 animals produced at the former Fort Robinson, Nebr., Beef Cattle Research Station and at the cooperating University of Nebraska, Lincoln.

With these data, they estimated heritability and correlation of traits, then used the estimates to compare accuracy of various combinations of traits in predicting breeding value for efficiency of beef production. Efficiency was defined as the value of essentially boneless retail cuts, adjusted for marbling score, less postweaning feed and time-variable costs, but with no cost differential for varying weight at weaning.

Evaluation of efficiency at a standard age of slaughter was preferable to evaluation at a standard slaughter weight, Dr. Dickerson says, largely because no extra cost was assumed for heavier weaning weights. Successful selection for faster growth will lead to heavier calf weights at a given postweaning feed conversion ratio with little change in fatness. Such selection will encourage heavier live weights at weaning and at slaughter and thus reduce cow-herd costs per pound of meat in spite of the associated increase in cow size.

In the final step of the study, the researchers extended evaluation at a standard slaughterage to include expected changes in cow-herd costs from associated increases in cow size, birthweight, calving difficulty, and fertility. The proposed selection indexes for what Dr. Dickerson terms net production efficiency, take these costs into account.

Associated with Dr. Dickerson in the study were Larry V. Cundiff and Keith E. Gregory of ARS, and Niklaus Kunzi, Robert M. Koch, and Vincent E. Arthaud of the University of Nebraska.—*W.W.M.*

A light-scaled, first generation female (0576X492–20) and a dark-scaled, first generation male (0576X492–27) feed on cotton squares with the bracts removed.

TO MARK THE MALE

A RECESSIVE sex-linked mutant of the boll weevil may hold the key to successful releases of sterile males in eradication efforts.

From a single dark male weevil found in an ebony body-colored parent colony, a pure very dark strain was established. The dark appearance was caused by dark scales on the dorsal surface of the body. Scientists scraped off the scales from both dark-scaled and normal weevils and found the body colors of the weevils to be indistinguishable, an exploitable circumstance.

When dark-scaled females are crossed with light-scaled males, all first generation (F_1) males are dark-scaled and all F_1 females are light-scaled. The sexes then are easily distinguishable with the unaided eye.

Said ARS entomologist Eric J. Villavaso at the Cotton Insects Physiology Laboratory (4115 Gourrier Avenue, Baton Rouge, LA 70808), "Both the time consumed in microscope-aided sexing and the amount of handling re-

ceived by males to be treated and released could be greatly reduced.

"Females could be picked off and discarded without ever touching the males in most cases. This is highly important because presently only males can be sterilized virtually 100 percent. Females retain some fertility. But the greatest potential for use of the dark-scale characteristic is that it may allow mechanical sexing by use of a photoelectric sensing system."

A prototype model of an automated sex-separation scheme is planned by collaborating scientists at the Metabolism and Radiation Research Laboratory in Fargo, N.D. A weevil separator would automatically move weevils into single-file and drop them through a drop-tube at the rate of 10,000 weevils per hour. A photoelectric sensing system containing a light source and receiver combination would then detect whether a light-scaled or dark-scaled weevil had fallen through it.

In the sexing method used in the pilot eradication experiment, scientists used microscope-aided sexing of 1,500 adults to obtain 750 males, along with some mis-sexed females. This was a tedious and time-consuming process. One person could sex an average of only 800 weevils per hour.

Over a 2-week egg-laying period, 50 dark-scaled females and 50 light-scaled males could produce 1,500 progeny of which 750 would be expected to be males. Use of the dark-scaled strain would necessitate microscope sexing of only 200 adults (100 of each strain) to produce 750 males.

If not accomplished mechanically, sex separation could be done by unskilled personnel with a minimum of handling and a minimum of sexing error. In any case, says Dr. Villavaso, microscope-aided sexing could be reduced by 87 percent. If a female sterilant such as Dimilin can be used, the reduction in microscope-aided sexing may be as much as 93 percent.

Although the dark-scaled strain is not as productive as the normal ebony strain, improved adult diet formulations using powdered freeze-dried cotton squares have resulted in twice as many progeny as the regular adult diet produces.

In a pilot sterilization test conducted by entomologist Norman W. Earle at the Baton Rouge laboratory, the dark-scaled males did not differ in longevity or sterility from normal-scaled males.

The potential for using the dark-scale marker in the boll weevil eradication program is great. The mutant may also be useful in isolating induced mutations such as male sterility and temperature sensitivity.

A cost-benefit study of the sexing procedure is being planned at Baton Rouge.—*P.L.G.*

Dr. Villavaso checks the emergence rates of eggs from boll weevils on various special laboratory diets fortified with freeze-dried cotton square powder. The rate of emergence on a standard size diet is about 35 percent. When freeze-dried cotton square powder is added, however, the emergence rate jumps to approximately 70 percent (0576X494-8A).

Mechanical engineering technician Craig L. Folk feeds tufts of raw cotton as produced by the Bale-Opener-Blender into the hopper of the integrated yarn processing system. The system is divided into three stages. The first stage, of which the hopper is a part, comprises initial opening, cleaning, and lap forming. The hopper is equipped with a system for producing a continuous lap of fiber of constant uniformity. This control is achieved by an electro-optical sensor that maintains a constant level of fibers in the hopper (0576X491–11).

Closer to the dream

ARS SCIENTISTS have designed, built, and operated a prototype cotton processing system to continuously process raw cotton stock into yarn.

The new system does a job that requires at least six separate attendant-operated machines in present-day cotton textile mills. The experimental system was developed by scientists at the Southern Regional Research Center (P.O. Box 19687, New Orleans, LA 70179).

Although still a long way from being ready for commercial application, the new machine has caused a flurry of excitement in the textile industry which has long recognized the need for radically new processing equipment.

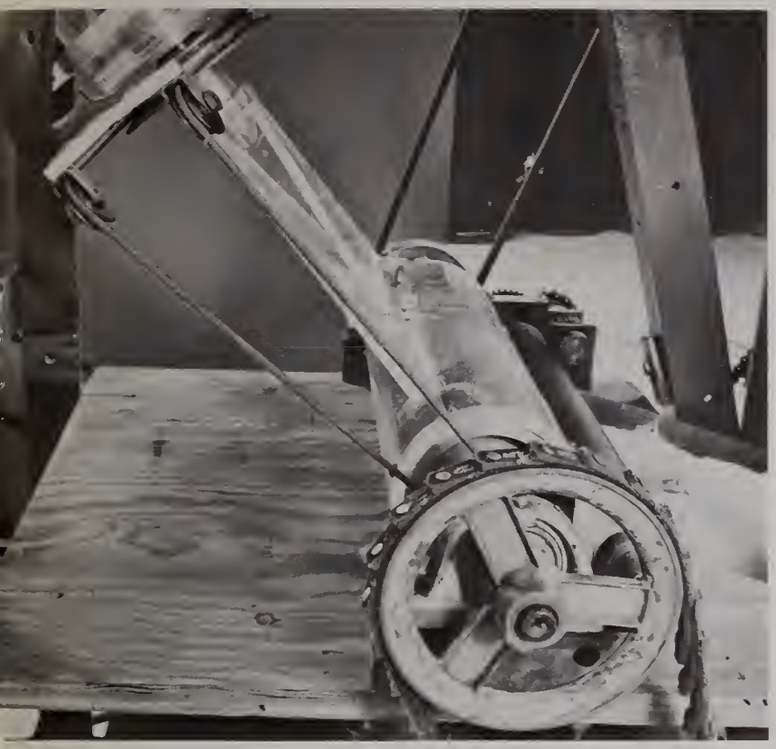
The cotton textile processing system now in use has remained basically unchanged for two centuries. Improvements have been made to individual items of equipment to make them more efficient, but the basic concept remains unchanged and is rapidly becoming uneconomic.

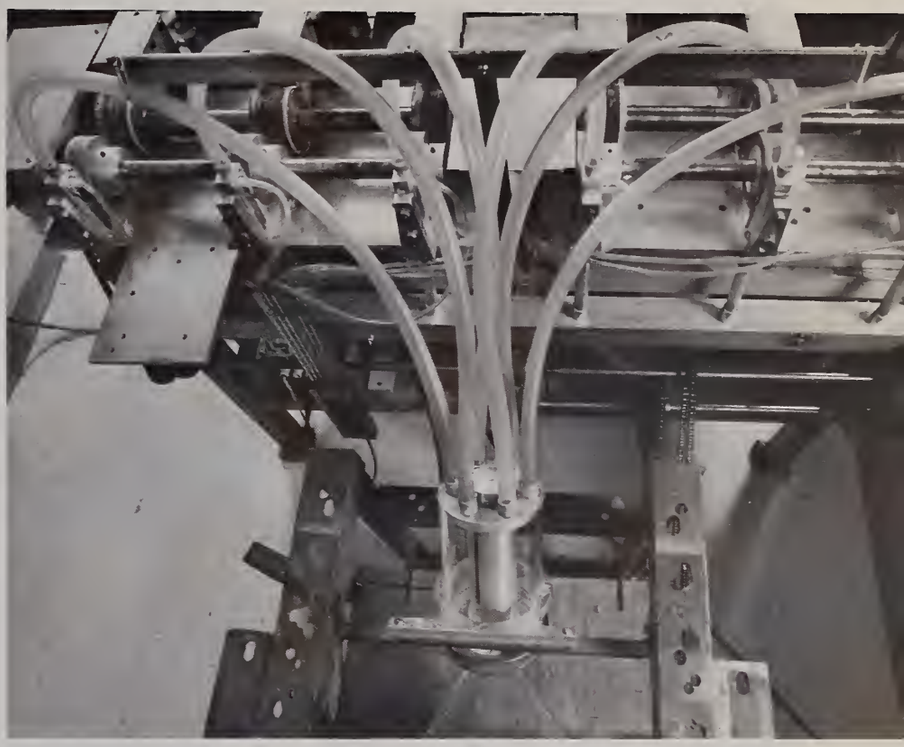
In conventional processing, after baled cotton is opened into small tufts it is put through a cleaner, then through a picker where cleaning is continued and the cotton is formed into a lap or batt. Next it is carded and formed into a loose rope of fibers called a sliver. These slivers are then sent to a drawing frame where several are brought together and drawn out into a single sliver to help straighten the fibers and improve uniformity.

The sliver is then drawn into a smaller strand called roving which in turn goes to the spinning frame where the fibers are finally spun into yarn. With the exception of movement of the cotton from the cleaner to the picker, semiskilled attendants move the cotton from machine to machine and operate the machinery.

The concepts leading to the new system have proved viable on a bench scale; the scientists are certain they will prove viable next on a pilot scale and then on a mill scale.

The prototype system operates by feeding tufts of raw cotton into a vertical chute or hopper which is separated into upper and lower chambers by a tuft opening device. The opened tufts, ranging in weight from 0.2 to 0.3 gram, are deposited in the lower chamber with little air turbulence, allowing the tufts





The second stage consists of intermediate opening, cleaning, and fiber doffing, or removing (0576X491–15). During distribution and blending—the heart of the new process—fibers are dispersed into a cylindrical chamber where they are blended and subdivided into multiple outlets (0576X490–21A).

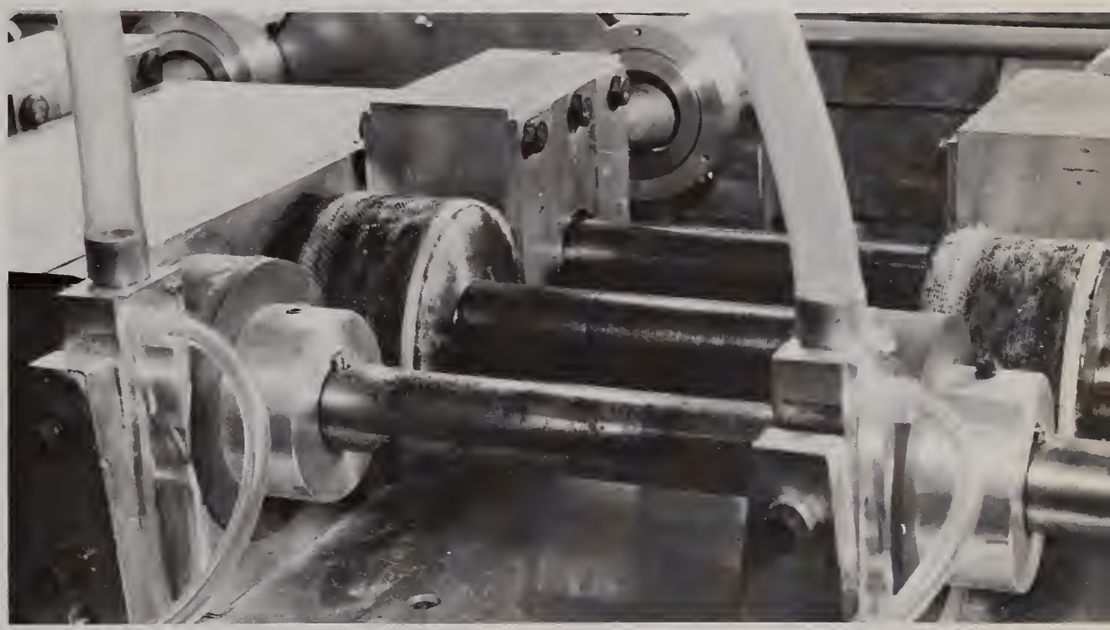
to settle gently and uniformly onto conveyor belts where the cotton is formed into a uniform lap.

The lap is fed into a device where it is converted into extremely fine tufts and individual fibers. The opened or separated fibers are then fed to a distributor where they are formed into a uniform, continuous ribbon of fibers which can then be individualized and parallelized for spinning into yarn by what is known as an open-end spinning system.

The final tests of any new system must be its economics and the quality of yarn produced.

In present mills, one of the most important economic factors is the cost of labor. The new system would eliminate more than 60 percent of the labor now required, although the remaining labor force would have to be upgraded to operate and maintain the more complex equipment.

The yarn produced by the prototype machine is somewhat irregular in ap-



The third stage includes fiber individualizing, yarn forming, and winding (0576X490–15A).

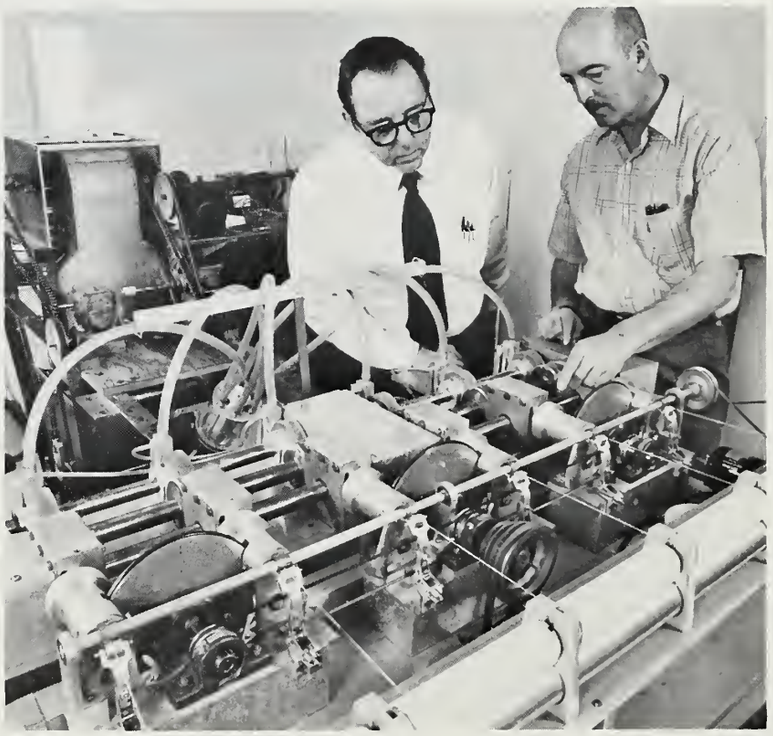
pearance and does not meet current standards. However, studies are underway to improve yarn quality and the scientists say quality will improve as the equipment is improved and refined.

Another plus for the new system, when it is ready for commercial development, will be its ability to allow mills to meet the increasingly stringent regulations concerning noise and dust levels. The entire yarn-making procedure will be in a closed system that will confine dust and drastically reduce the noise level.

Development of a closed, continuous cotton processing system is not a new idea. It has been a dream for many years. But it was Ralph A. Rusca, retired former chief of the Center's Textile Processing Laboratory, who envisioned the system and who more than 10 years ago initiated and supervised much of the research that has resulted in the prototype.

Since then a team of more than a dozen scientists and technicians, and now under the leadership of research physicist Albert Baril, Jr., has continued studies of the effects on cotton of electrostatic, aerodynamic, hypersonic, and magnetic forces. From these studies came the individual components which make up the prototype equipment that is leading the way to a revolution in the textile industry. Big changes are ahead for an industry which has employed a processing system that has remained conceptionally unchanged since the introduction of power-driven machinery brought about the industrial revolution more than 200 years ago.—*V.R.B.*

Top: *The self-cleaning spinning cup and the conical deflector (0576X490–4A), which operates on the principle of the Coanda effect whereby fibers impinging on the surface of the deflector are spread out into the periphery of the spinning cup, are revolutionary components of the open-end yarn spinning rotor.* ***Below:*** *James I. Kotter, research mechanical engineer, and Mr. Folk examine the uniquely designed open-end yarn spinning rotor (0576X490–37A).*



The best weapon against EIA

In recent tests involving most of the important commercial disinfectants, phenolic compounds proved overall to be the most effective and safest means of helping horse owners to control Equine Infectious Anemia (EIA).

This world-wide virus disease, particularly serious in hot, humid areas where there are many insects, can kill a horse, or debilitate the animal for the rest of its life. Presently, 2 percent of the U.S. horse population suffers from EIA.

The virus can be transmitted from a mare to her offspring; from insects (especially the horsefly); or through contamination from marking equipment, tack, or even a stall that has been occupied at one time by an infected horse.

To prevent EIA contamination, equipment and stalls should be sterilized. ARS microbiologist David T. Shen, and veterinarian John R. Gorham (Wegner Hall, Washington State University, Pullman, WA 99163), in cooperation with Washington State University veterinarian Kenneth Crawford, evaluated leading disinfectants for effectiveness in helping to control the spread of EIA. Disinfectants they studied included alcohol, formalin, iodine, acetic acid, lye, chlorine, and phenolic compounds.

EIA is easy to kill and all of the tested disinfectants quickly dispatched the virus. Chlorine and iodine were the fastest-working disinfectants, but both lost their effectiveness in the presence of organic matter like manure.

Though less speedy, phenolic compounds were not affected by the presence of organic matter, and proved safer to use than the other disinfectants which were studied. Exposure to two commercial brands of phenolic compounds at recommended concentrations destroyed all detectable levels of EIA virus within 1 minute. Phenolic compounds proved effective even at 1/10th the recommended concentration.—*L.C.Y.*

Controlling codling moths in sweet cherries

Scientists have perfected a technique that achieves complete control of codling moths in harvested sweet cherries with no detectable effects upon the quality or taste of the treated fruit.

Codling moths are not an economic problem of sweet cherries in this country and naturally occurring infestations are rare. That they do occur, however, has been an impediment to sales to foreign countries that maintain quarantines to prevent introduction of the pests. The new treatment gives 100 percent control, thereby removing one more important barrier to negotiating trade agreements and foreign sales that include U.S. produced cherries.

The technique involves fumigating harvested cherries with methyl bromide at a concentration of 32 grams per cubic meter for 2 hours at 24°C.

The study was conducted by ARS entomologist Harold R. Moffitt (3706 W. Nob Hill Blvd., Yakima, WA 98902) and Washington State University entomologist E. W. Anthon and ARS plant physiologist H. Melvin Couey (Box 99, P.O. Annex, Wenatchee, WA 98801).

The study involved approximately 164,000 cherries. Because of the rarity of natural infestation, the researchers artificially infested the fruit to obtain the large numbers of infested cherries required for their study.

Trees of each major cherry tree variety—Bing, Van, and Lambert—were infested with adult codling moths. Rates of fruit infestation were 92.6, 92.8, and 91.3 percent, respectively.

After fumigation, the fumigated cherries were aerated for 2 hours, then placed in cardboard rearing trays. The trays were held under optimal moth-rearing conditions for 40 days to determine the survival and subsequent development of codling moth larvae. During this period, the researchers periodically examined the fruit for the presence of live larvae and adult moths.

No codling moth larvae survived fumigation, while 5,450 larvae developed in the nonfumigated cherries.

In subsequent taste tests, tasters were provided treated and nontreated samples of cherries and told to distinguish between the two and select the samples they preferred. Selections could be based on appearance, flavor, or texture. There were no significant taste differences detected between fumigated and nonfumigated cherries, and preferences showed no discernible pattern.—*L.C.Y.*

*Above: Thermocoupled fruit is arranged in the bulk loader by Dr. Baird (**left**) and Dr. Gaffney. The flexible tube in foreground is part of the system used to heat the fruit to a constant temperature for the experiment. The bulk loader will then be rolled into the cooling chamber (0276X145–7). **Right:** Dr. Baird inserts thermocouples at various points within the peppers. The thermocouples sense temperature variations in the fruit during the cooling process, and, at predetermined levels, measure temperature of the air surrounding the fruit (0276X144–27A).*

Cooling Bell Peppers

NEW, HIGHLY sophisticated cooling equipment adaptable to commercial systems is enabling researchers to develop information for designing more effective and efficient air cooling systems for fruits and vegetables, including bell peppers.

The new cooling unit was designed to allow precise measurement and control of all of the important variables involved in cooling of fruits and vegetables. ARS agricultural engineer Jerome J. Gaffney, Handling and Facilities Research Unit (102 Agricultural Engineering Building, University of Florida, Gainesville, FL 32600), and assistant professor C. D. Baird, University of Florida Agricultural Engineering Department, cooperated in the research.

Industry agrees that better equipment and procedures are badly needed for cooling citrus fruits, avocados, peppers, and snap beans prior to shipping. "Consumers are paying the bill for damaged bell peppers," says Mr. Gaffney. "And these losses are expensive, probably 15 percent of the product. Florida is responsible for 6.3 million bushels annually with a shipping point value of over $31 million. This represents about one-half of the total U.S. pepper production for a season. Minimizing losses may be more important than increasing yields. When bell peppers are discarded in marketing channels, the cost is added to the product."

The study on bell peppers was undertaken to determine the cooling rates of the fruit in bulk loads as a function of air flow rate and air temperature.

Cooling tests used on peppers (Early Calwonder variety) were initiated 2 days after the fruit were harvested and continued over a period of 6 days. The research unit circulated air through the product load at a constant flow rate and constant temperature for a given experiment. Temperatures were measured with 36-gage thermocouples connected to a digital data acquisition system, and temperature values were recorded on magnetic tape. The air flow rate

through the product chamber was measured by passing the total volume of air through round ducts equipped with calibrated differential pressure type elements.

Six peppers of about average weight and size were selected for use in measuring temperatures with thermocouples during cooling. Their wall thickness varied from 0.27 inch to 0.24 inch. They were cooled in a 24-inch square mesh-bottom container; fruit were placed to a depth of 24 inches and two peppers with thermocouples were positioned at the bottom of the load, two at the middle, and two at the top. The average weight was 0.35 pound, and the average height and diameter were 3.34 and 3.38 inches, respectively.

Before the start of each test, the air in the cooling unit was maintained at 35° F and the fan rpm was preset to provide the desired air flow for that test. When the fruit were warmed to 90° F a test was begun by immediately rolling the product container into the cooler and starting the data recording system.

In typical temperature response data for low air flow rates, the difference between temperatures at different locations within the peppers at a given location in the load was rather small, but the gradient between the bottom and top of the load was considerable. At high air flow rates, the temperature differences were greater within individual peppers but less within the load.

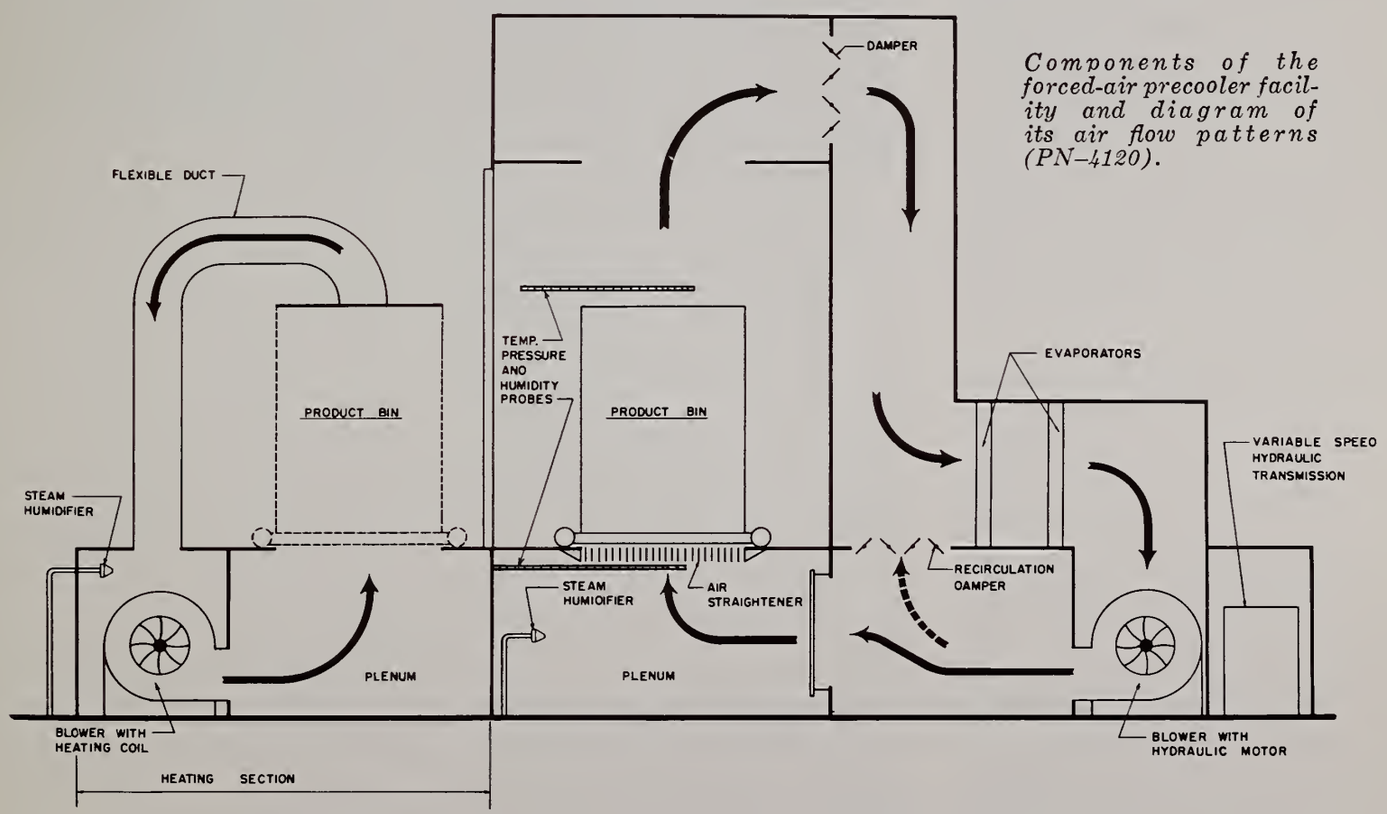
In general, the moisture loss was greater for the tests with lower air flow rates, probably because they lasted longer and the product was exposed to a vapor pressure deficit for a longer period. When time was taken into account by dividing the moisture loss by the test time, the moisture loss per hour was greater for the higher flow rates. The tests indicated that air cooling of peppers does not cause a significant moisture loss in the product during cooling, particularly at higher air flow rates. Slight changes in moisture content probably do not significantly affect the rate of cooling.

Other general conclusions: doubling the air velocity will decrease the cooling time by approximately 40 percent but will increase the fan power requirements by over four times. Lower air temperatures will result in faster cooling rates but the refrigeration equipment costs and operating costs will be greater than for higher air temperatures.

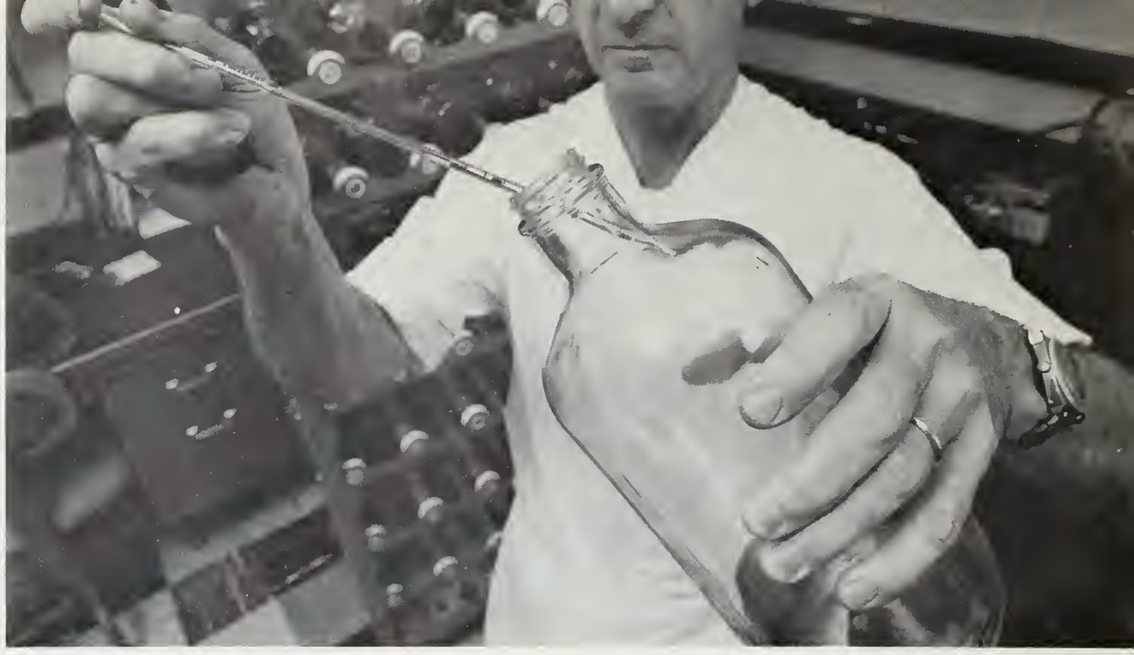
Depending on air flow, the cooling time for a given temperature reduction in peppers with a wall thickness of 0.18 inch would range from 25 to 35 percent less than those used in this study. For peppers with a wall thickness of 0.28 inch, the cooling time would be about 15 percent greater.

The Gainesville researchers are also working on a mathematical cooling model for peppers and other products which will describe the cooling response for any product depth in the direction of air flow.

The model, says Mr. Gaffney, is economical when compared with obtaining the same information experimentally. It requires $2 in computer costs and a relatively few minutes to determine product cooling response data for a particular set of conditions by use of the model, whereas an equivalent experiment might require two people working 1½ days.—*P.L.G.*



Components of the forced-air precooler facility and diagram of its air flow patterns (PN–4120).



Dr. McClurkin introduces a virus killing agent, acetylethyleneimine, to BVD virus growing in cell cultures. The experimental vaccine is made from killed BVD virus (1275X2327–6).

Safe vaccine for pregnant cows

An experimental vaccine for bovine viral diarrhea (BVD) has two advantages over vaccines now available to cattlemen. It is safe to use on pregnant cows, and it does not produce adverse reactions after vaccination.

In tests at the National Animal Disease Center (P.O. Box 70, Ames, IA 50010) the inactivated vaccine protected both pregnant cows and their unborn calves from BVD virus infection. It thus may fill the need for a safe BVD vaccine for use in beef and dairy cow-calf operations, where cows may be in all stages of pregnancy.

Effective vaccines for the bovine viral diarrhea-mucosal disease complex are available, but their use on pregnant cows usually is not recommended. The risk of BVD virus infections of the calves they are carrying is too great.

Only live modified virus vaccines for BVD are now marketed, explains ARS veterinary medical officer Arlan W. McClurkin. BVD virus introduced by their use can pass the placenta and infect the fetus at all stages of gestation. The result may be abortion, stillbirth, or malformation, weakness, and diarrhea in the calf, particularly if infection occurs in the first half of pregnancy.

Under some conditions, use of available BVD vaccines may produce a severe reaction after vaccination. In contrast, Dr. McClurkin found no clinical evidence of adverse reaction in tests with the inactivated vaccine.

Dr. McClurkin, ARS microbiologist Manual F. Coria, and technician Robert F. Smith used acetylethyleneimine as the inactivating agent in preparing the vaccine. Advantages of this agent were demonstrated by ARS scientists at the Plum Island Animal Disease Center, Greenport, N.Y., who used it in producing a killed foot-and-mouth disease vaccine.

The researchers' first experiment tested effectiveness and safety of the inactivated vaccine. They vaccinated five of nine cows that were 2 to 4 months pregnant and challenge-exposed all nine cows with BVD virus a month later.

All five vaccinated cows but only one of four not vaccinated produced healthy calves. No live virus was demonstrated in the vaccine, and serological tests showed no evidence of virus spread from vaccinated to control cows.

A second experiment tested the ability of concentrated killed BVD vaccine, in a single injection, to protect pregnant cows and their unborn calves from infection.

The 19 cows in this experiment had been pregnant 3½ to 6½ months when 14 of them were vaccinated. A different, possibly less virulent strain of BVD virus was used in challenge exposure.

All vaccinated cows produced antibodies to BVD virus, and all nonvaccinated cows developed uterine infections. In contrast with the first experiment, all cows delivered healthy calves. Other studies indicate that the fetus is most susceptible to BVD virus infection in the first half of pregnancy, as in the first experiment, and a fetus infected in the second half of pregnancy is most likely to respond with antibody production, as generally occurred in the second experiment.—*W.W.M.*

New Yearbook: Face of Rural America

Heidi Evans hugs her prize-winning sheep at last year's Ohio State Fair. More than 50 photographers across the Nation were invited to record rural America at work and play for the latest Yearbook of Agriculture (026–7–23).

A PANORAMA of modern farming is featured in the 1976 Yearbook of Agriculture—*The Face of Rural America*—a photo book of American agriculture.

It is the first photo yearbook in a series reaching back to 1894. A selected group of photographers was asked to photograph typical rural America at work and at play during 1975 and 1976. This is USDA's major Bicentennial project.

The large picture book contains 288 pages and 335 photographs, 316 black and white and 19 color photos. They feature farming, farm families, and country living of 1976.

Secretary of Agriculture Earl L. Butz noted that if someone had been able to put together a good book of photographs in 1776 showing Colonial life as it really was, that book would be invaluable today.

The Face of Rural America is the 77th volume to carry the title Yearbook of Agriculture. This designation formally began with the 1894 volume and a yearbook has been issued annually since, with a few exceptions—due principally to wartime suspension of publication.

Copies of *The Face of Rural America* may be purchased for $7.30 each from government bookstores or by sending a check or money order to: Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Members of Congress have a limited number of copies for free distribution to constituents.

Shallow drainage systems

WET GROUND means late planting and late planting means smaller yields. For corn, each day lost after optimum planting time costs about a bushel and a half per acre.

For farmers working claypan and fragipan soils in Illinois, Indiana, Missouri, and Ohio, every spring is a race to get crops in between rain storms. Although they nearly always get the planting done eventually, it is often too late to produce optimum yields and some years they are forced to switch to a shorter season and less profitable crop.

Soil scientist Norman R. Fausey (No. Appalachian Watershed, Box 478, Coshocton, OH 43812) thinks that shallow drainage systems, using 2-inch corrugated plastic draintubes installed 16 to 20 inches deep, may be the solution.

Although Dr. Fausey still calls shallow drainage a "concept," he says farmers are putting in shallow drainage systems. And he has 5 years of data comparing the shallow drainage system favorably with 3-foot-deep tile systems. His research was conducted on plots near Castalia, Ohio, on a poorly drained Toledo silty clay soil.

"The shallow system moves the excess water out faster, is easy to install, and requires less power to put in than the deeper drains," Dr. Fausey says. "More materials are needed for the shallow system because the lines are only 20 feet apart while the deeper drains in the control plots were 40 feet apart."

The hardpan and claypan layers create the problems because they restrict water movement downward even when drainage systems have been installed. The problems of wet soil are many, including delayed planting, mired equipment, compaction of soil, delayed harvesting, and increased costs of going back to plant wet spots.

"Traditionally, subsurface drainage has not been recommended for soils with impermeable or very slowly permeable shallow layers because experience showed drains placed in or below such layers do not effectively lower the water table," Dr. Fausey says. "Placing drains above these restrictive layers has not been recommended because the conventional ceramic drains would be subject to damage by soil frost action and heavy loads from farming equipment traffic."

The recent development of corrugated plastic draintubes and draintube plows makes shallow subsurface drains look much more feasible, he said. Five years after installation the drain lines were inspected, and showed no deformation under normal farming operations which included plowing.—*R.G.P.*

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Shipping diseased plant material

SCIENCE knows no national borders, but shipping diseased plant material internationally can be a problem. Nations, to protect their agriculture, have rigidly enforced regulations regarding plant material crossing their borders.

Now, ARS plant pathologist Natale Zummo (U.S. Sugar Crops Field Station, Route 10, Box 152, Meridian, MS 39201) has devised a simple method for killing and preserving diseased plant material for shipment across international borders.

The treatment ensures that the diseased material is completely sterile and can be shipped through the regular post without violating any national quarantine regulations.

The plant specimens retain their color for at least 5 years and can be used for research, reference, and classroom teaching.

Dr. Zummo, working with foliar diseases of sorghum in the United States, and with maize, millet, and sorghum diseases in West Africa, uses a killing solution made up of formaldehyde, ethanol, glacial acetic acid, oil of cloves, copper sulphate, aspirin, and water. He allows the mixture to stand for 1 day so that the ingredients will go into solution.

The diseased plant material is then placed in the solution for 3 to 5 days. The material is not washed prior to treatment to ensure that the disease organisms and structures, such as rust and fungal fruit, are attached.

After spending time in the solution, the plant material is then dried in a plant press for 1 to 3 days and heat sealed in heavy plastic envelopes. If the material contains thick stalks, a small amount of the killing solution is sealed in with the plant.

The sterile, sealed material can now be shipped conveniently through the regular mail.

This procedure should prove valuable to plant pathologists working worldwide with plant diseases, that, like the science that studies them, recognizes no political boundaries.—*B.D.C.*

R_x for soft raisins

A HEAT TREATMENT for raisins destined for the breakfast cereal trade immediately imparts a softer texture and keeps them softer than untreated raisins during storage.

Chemist Harold R. Bolin (ARS, USDA, 2850 Telegraph Ave., Berkeley, CA 94705) developed this technique after hearing industry complaints that raisins become hard and chewy when added to breakfast cereals. The heat treatment also inhibits sugar crystals from forming on the raisins during storage.

Dr. Bolin found that the best treatment involved heating the raisins in a conventional oven for 48 hours at about 120° F (49° C). This causes a slight darkening of the raisins but gives them a moist texture and appearance. Even after storage for 10 months at 72° F (22° C), the raisins had no visible crystals on the surface.

Treatment in a microwave oven proved unsatisfactory because the heating time was too short to allow the sugar seed crystals to dissolve and be dispersed within the raisins.

Dr. Bolin also tested coating the raisins with sugars, flours, and starches to reduce moisture loss, but none of these proved effective. One coating that significantly reduced moisture loss during storage was protein, either from egg albumen or solubilized soy. This coating has the additional advantage of increasing the protein content of the fruit.—*D.H.S.*

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